

## New and little-known Bryozoa from Antarctica and the southwest Atlantic

by P. J. HAYWARD and J. S. RYLAND

**Abstract.** — Eight species of cheilostome Bryozoa are described from Antarctica and the magellanic southwest Atlantic. Five new species are recognized, in the genera *Escharoides*, *Cellarinella* and *Inversiula*. *Cellarinella roydsi* Rogick is regarded as a junior synonym of *C. watersi* Calvet. WATERS' (1904) records of *Bifaxaria denticulata* and *Bifaxaria rustica* from the Bellingshausen Sea are referred to *Cellarinella virgula* sp. nov.

**Résumé.** — Les auteurs décrivent huit espèces de Bryozoaires Cheilostomes provenant de l'Antarctique et de la région magellanique du sud-ouest atlantique. Cinq nouvelles espèces, appartenant aux genres *Escharoides*, *Cellarinella* et *Inversiula*, y sont reconnues. *Cellarinella roydsi* est considérée comme étant un « junior synonym » de *C. watersi* Calvet. Les signalisations de WATERS (1904) concernant la présence en mer de Bellingshausen de *Bifaxaria denticulata* et de *Bifaxaria rustica* se rapportent à une nouvelle espèce, *Cellarinella virgula* n. sp.

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The cheilostome Bryozoa of Antarctica and adjacent subantarctic regions are presently attracting renewed interest from marine biologists and ecologists after a considerable period of neglect. Bryozoan faunas of these regions are known to be rich, with high levels of endemism (ROGICK, 1965), and in some areas of the Antarctic shelf seas comprise a significant proportion of the sessile benthos (BULLIVANT, 1967). However, many of the species described by earlier authors (e.g., JULLIEN, 1888; CALVET 1904, 1909; WATERS, 1904) have never been adequately redescribed and remain poorly characterized, and in Antarctic coastal waters in particular the fauna includes a high proportion of undescribed species. In systematic research on the Antarctic Bryozoa it is important to re-examine type and original materials of previously described species, not least because scanning electron microscopy now permits a more informed understanding of the skeletal morphological characters on which bryozoan taxonomy is largely based. The species descriptions given by earlier authors are frequently brief, and their illustrations are generally inadequate and do not help in distinguishing between closely similar species. Taxonomic precision is especially important in describing the faunas of western Antarctica and the Scotia Arc, which to some extent seem to constitute a transitional zone between the magellanic and Antarctic zoogeographical realms. Very few bryozoan species have geographical distributions which encompass both realms, and apparently geographically widespread species most often prove to comprise two or more superficially similar taxa.

In this present account eight species of cheilostome Bryozoa are described from the collections of Antarctic Bryozoa accumulated by the Institute of Oceanographic Sciences,

Deacon Laboratory, Wormley, England. Three new species are described in the endemic Antarctic genus *Cellarinella*. The comparatively well-known *Cellarinella roydsi* Rogick is shown to be a junior synonym of the rarely reported *C. watersi* Calvet, following re-examination of CALVET's holotype specimen. Two species of *Bifaxaria* described by WATERS (1904) from the Bellingshausen Sea are referred to *Cellarinella virgula* sp. nov. *Schizoporella pellucidula* Calvet is shown to belong to the southern hemisphere genus *Hippomonavella*. A new species of *Escharoides* is described from South Georgia, and *Inversiula nutrix* Jullien, an endemic magellanic species which ranges south to the Antarctic Peninsula, is distinguished from a second species which is perhaps limited to the Patagonian Shelf. All I.O.S. specimens listed have been deposited in the Bryozoa Section, Department of Zoology, the Natural History Museum, London. Registration numbers of type specimens are indicated by the prefixes BMNH (Natural History Museum, London), or MNHN (Muséum National d'Histoire Naturelle, Paris). Details of collecting stations are given hereafter.

DETAILS OF COLLECTING STATIONS

« *Discovery* » Stations

- 152 : 17.01.1927. Off South Georgia. 53°51.5' S, 36°18.5' W. 245 m.  
 160 : 07.02.1927. Near Shag Rocks. 53°43.6' S, 40°57' W. 177 m.  
 164 : 18.02.1927. Normanna Strait, South Orkneys. 24-36 m.  
 179 : 09.03.1927. Melchior Id., Schollaert Channel, Palmer Archipelago.  
 456 : 18.10.1930. Off Bouvet Island. 40-45 m.  
 1660 : 27.01.1936. Ross Sea. 74°46.4' S, 178°23.4' E. 351 m.  
 1948 : 04.01.1937. N. of Clarence & Elephant Is. 60°49.4' S, 52°40' W. 490-610 m.  
 WS25 : 17.12.1926. Undine Harbour, South Georgia. 18-27 m.  
 WS27 : 19.12.1926. Off South Georgia. 106-109 m.  
 WS33 : 21.12.1926. Off South Georgia. 130 m.  
 WS42 : 07.01.1927. Off South Georgia. 198 m.

« *Terra Nova* » Stations

- 314 : 23.02.1911. Off Inaccessible Id., McMurdo Sound, Ross Sea. 406-441 m.

Family EXOCHELLIDAE Bassler, 1935

Genus ESCHAROIDES Milne Edwards, 1836

*Escharoides torquata* sp. nov.

(Plate I, A-C)

MATERIAL. — Holotype : BMNH 1990.12.13.1, Discovery Stn. 152; paratype : BMNH 1990.12.13.2, Discovery Stn. 152.

DESCRIPTION

Colony forming a thick, encrusting, unilaminar sheet. Autozooids broadly oval to hexagonal, convex, separated by deep grooves; frontal wall thick, smooth and with a few fine

longitudinal corrugations, with well marked marginal pores. Proximal lip of aperture produced as a stout, angular, median mucro; its inner rim with an anvil-shaped median denticle. Four short, club-shaped, distal oral spines present in newly budded autozooids, two persisting in ovicelled autozooids. Avicularia abundant : typically one on each side of the mucro, slightly acute to frontal plane and directed laterally ; others then develop, closely juxtaposed, around the whole periphery of the autozooid, forming a closed ring of avicularia with varying orientation ; rostrum oval, slightly raised distally, 0.1-0.2 mm long, with complete crossbar. Ovicell about as wide as long, smooth surfaced, with a slight apertural lip. Large and capacious basal pore chambers present.

*Measurements* (mm)

	n	$\bar{x}$	s.d.
Autozooid length	20	1.15	$\pm 0.10$
Autozooid width	20	0.81	$\pm 0.08$

REMARKS

*Escharoides torquata* is distinguished from all other species of *Escharoides* by its remarkable battery of avicularia, and by the pronounced denticulation of the inner, proximal edge of the aperture. The material described here was collected from a single station off South Georgia.

Family CELLARINELLIDAE Moyano, 1970

Genus CELLARINELLA Waters, 1904

*Cellarinella anomala* sp. nov.

(Plate I, D ; II, A-B)

MATERIAL. — Holotype : BMNH 1990.12.13.3, Discovery Stn. WS42; paratypes : BMNH 1990.12.13.4, Discovery Stn. WS42.

DESCRIPTION

Colony erect, with flat, curved or irregularly twisted branches, dividing irregularly to give broad lobes, or narrow strap-like rami ; typically narrow at the base, rarely exceeding 6 mm wide, but tending to broaden abruptly to 20 mm or more, and then to divide into a number of unequal rami. Basal attachment unknown. Autozooid boundaries obliterated in earliest ontogeny by reticulate frontal calcification ; the colony surface appearing uniform, regularly perforated by deep, angular pits, only the apertures marking the position of each autozooid. At the base of the colony all autozooid apertures are obscured by thick, uniformly reticulate calcification. Autozooid aperture wider than long, more or less semicircular, with a smooth, transverse proximal oral shelf ; at the growing edge, before the completion of the aperture rim,

a broad distal oral shelf may be seen, but there is no internal avicularium. Most autozooids with a single frontal avicularium, proximal to aperture, the rostrum oval, slightly acute to frontal plane and directed proximo-laterally. In a minority of autozooids a second, larger avicularium may be present, lodged within the proximal edge of the aperture, transversely orientated, with a curved, sharply hooked rostrum. Ovicell longer than wide, imperforate, but becoming submerged in reticulate calcification; brooding autozooids may be recognised by a thickened, projecting, proximal apertural lip, which may incorporate, on one or both sides a small, distally directed avicularium, with hooked rostrum.

*Measurements (mm)*

	n	$\bar{x}$	s.d.
Aperture length	20	0.10	$\pm 0.09$
Aperture width	20	0.22	$\pm 0.01$
Frontal avic. length	20	0.14	$\pm 0.008$
Apertural avic. length	10	0.24	$\pm 0.02$

REMARKS

This species has some resemblance to *C. latilaminata* Moyano, which also lacks internal avicularia, and in which the brooding autozooids develop swollen apertural lips, incorporating one or two avicularia. *C. anomala* is distinguished from *C. latilaminata* in its shorter aperture, which does not develop the stout proximal umbo seen in the latter, in its smaller, more rounded frontal avicularia, and in the dimorphic apertural avicularia, which do not occur in *C. latilaminata*. The colony of *C. latilaminata* forms broad, folded sheets, quite unlike the branching form of *C. anomala*.

*Cellarinella edita* sp. nov.

(Plate II, C-D)

MATERIAL. — Holotype : BMNH 1990.12.13.5, National Antarctic Expedition, McMurdo Sound, Ross Sea, 1.5.1903; paratype : BMNH 1990.12.13.6, National Antarctic Expedition, McMurdo Sound, Ross Sea, 1.5.1903. Other material : Terra Nova Stn. 314, Discovery Stn. 1660.

DESCRIPTION

Colony attached by an encrusting base to hard substrata, developing a slender, irregularly branching, three-dimensional form, exceeding 80 mm high, with an equivalent horizontal spread. Basal part of colony slender, cylindrical and smooth, the branches dividing dichotomously, flattening and twisting distally, broadening to a maximum width of 5-6 mm. Autozooids arranged in up to ten alternating, longitudinal series on each face of the branch, with a single series along each branch edge; strongly convex, with indistinct boundaries apparent at the growing edge, the entire frontal surface of the colony consisting of continuous, reticulate calcification. Aperture large, initially more or less D-shaped, but becoming more nearly round as ontogenetic thickening of the calcification proceeds; proximal border with a smooth, convex oral shelf projecting into the aperture, not readily visible in later ontogeny as the aperture becomes more deeply immersed. Frequently, a stout, conical umbo projects

distally from the proximal border of the aperture. A single avicularium present proximo-lateral to the aperture, with rounded, proximo-laterally directed rostrum, supporting a semicircular mandible. No internal avicularium. Ovicell wider than long, at first very prominent, with a wide orifice opening above the aperture of the brooding autozoid, which develops a projecting, spout-like proximal lip to the aperture; eventually becoming immersed in reticulate calcification.

*Measurements (mm)*

	n	$\bar{x}$	s.d.
Aperture length	20	0.29	$\pm 0.02$
Aperture width	20	0.27	$\pm 0.02$
Avicularium length	20	0.19	$\pm 0.01$

REMARKS

The elongate, slender colony of *C. edita*, which is attached by encrusting autozooids to such hard substrata as pebbles and small stones, distinguishes it immediately from other species of *Cellarinella* present in the Ross Sea, which are attached by flexible rhizoids. The rounded frontal avicularium, and the lack of an internal oral avicularium are also distinct specific characteristics.

*Cellarinella virgula* sp. nov.

(Plate III, A-C)

*Bifaxaria denticulata* : WATERS, 1904 : 59, pl. 8, figs. 14a, b.

*Bifaxaria rustica* : WATERS, 1904 : 60, pl. 8, figs. 19a, b.

MATERIAL. — Holotype : BMNH 1990.12.13.7, Discovery Stn. 1948; paratypes : BMNH 1990.12.13.8, Discovery Stn. 1948. Other material : Discovery Stn. 1948. IRB 309, 565 ("*Bifaxaria denticulata*"), 348 ("*B. rustica*") : Exp. Ant. Belgica.

DESCRIPTION

Colony forming a slender rod, attached to the substratum by chitinous rhizoids, branching dichotomously at frequent intervals; largest specimen 10 mm with a maximum width of 1 mm. Autozooids arranged in alternating, back to back pairs; slender, vase-like in profile with the proximal end distinctly tapered. Aperture terminal, irregularly pear-shaped in outline, with the proximal border comprising an obliquely-directed, curved, oral plate, and the edge of a horizontally orientated avicularium. Paired lateral suboral mucrones present, either or both with a small avicularium on the inner, median face, with oval, disto-laterally directed rostrum. In later ontogeny frontal thickening obscures both mucrones, the avicularia become indistinct, and the aperture deeply immersed and quite rounded.

REMARKS

*Cellarinella virgula* has a superficial resemblance to *C. laytoni* Rogick (plate III, B-D), which forms similar narrow, sparsely branched colonies. However, the larger autozooids of *C.*

*laytoni* are disposed in whorls of three to five, from early ontogeny, and never in the regular, alternating paired arrangement of *C. virgula*. *C. laytoni* is a much larger species than *C. virgula*, with very stout, prominent mucrones which give the colony a striking serrated profile; the suboral avicularia of *C. laytoni* are longer than those of *C. virgula*, with an elongate triangular mandible. WATERS' (1904) 'Belgica' specimens of "*Bifaxaria denticulata*" are clearly referable to *C. virgula*; each is slender, about 10 mm long and branched, the autozooids are arranged in alternating back-to-back pairs, with distinctly pear-shaped apertures within which the avicularia are clearly visible. The specimen of "*B. rustica*" is a dead, eroded fragment from the basal part of a colony; nevertheless, the characteristic arrangement of the autozooids and the morphology of the aperture are both distinct, and there is no doubt that it correctly belongs to *C. virgula*. The 'Discovery' specimens of this species all originate from a single station off the South Shetland Islands; the 'Belgica' material was collected from the Bellingshausen Sea.

### *Cellarinella watersi* Calvet

(Fig. 1; plate IV, A-B)

*Cellarinella watersi* Calvet, 1909 : 33, pl. 3, figs. 8-10.

?no1 *Cellarinella watersi* : LIVINGSTONE, 1928 : 51, pl. 1, figs. 8, 10.

*Cellarinella roydsi* Rogick, 1956 : 265, pl. 16, figs. J, K; pl. 17, figs. A-1.

*Cellarinella roydsi* : MOYANO, 1965 : 12, pl. 3, figs. 2-6; pl. 4, fig. 4.

MATERIAL. — Holotype : MNHN 5649, Baie Biscoe. Exp. Charcot. Other material : Signy Island, British Antarctic Survey, 1985; Discovery Sin. 160.

#### REMARKS

CALVET's (1909) original description of *C. watersi* was brief; he made no reference to the oral plate or the apertural umbo, and did not see the internal avicularium. Consequently, it is not surprising that few authors have managed to recognise it again. LIVINGSTONE's (1928) description is unhelpful (although he does describe a mucro and an internal avicularium), and his figures show a species with a proximo-laterally directed suboral avicularium, rather similar to *C. rogickae* Moyano. ANDROSOVA (1972) merely listed *C. watersi*, remarking that she had numerous specimens "corresponding to the typical ones". ROGICK's (1956) detailed and well illustrated account of *C. roydsi* could not apply to CALVET's published description and figures. However, comparing the holotype specimen of *C. watersi* with 'Discovery' specimens of *C. roydsi* (previously checked with ROGICK's material) shows that there is no doubt that the two taxa are synonymous. CALVET's specimen (fig. 1) is an almost complete, dichotomously branched colony (one ramus is now missing), 25 mm high, 3 mm wide at the base, with the distal lobe 10 mm wide. The curved edge of the oral plate is visible within each autozooid aperture, as is the distal tip of the internal avicularium. Most autozooids have a pronounced apertural mucro, and in a few towards the basal part of the colony, twinned apertural avicularia (as illustrated by ROGICK, 1956) can be seen.

*Cellarinella watersi* has a wide geographical distribution within Antarctica, encompassing South Georgia, the Weddell Sea, the Palmer Archipelago and the coasts of Graham Land, and the Ross Sea.

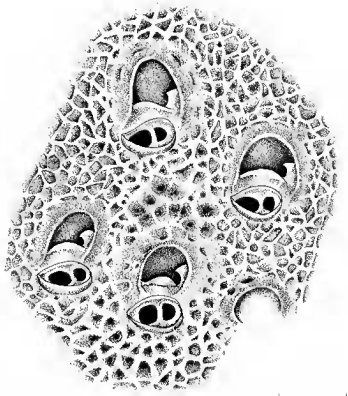


FIG. 1. — The holotype specimen of *Cellarinella watersi* Calvet. (Scale = 2mm.)

Family INVERSIULIDAE Vigneaux, 1949

Genus INVERSIULA Jullien, 1888

***Inversiula nutrix* Jullien**  
(Plate IV, C-D)

*Inversiula nutrix* Jullien, 1888 : 44, pl. 4, fig. 8.

*Inversiula nutrix* : CALVET, 1909 : 22; MOYANO, 1972 : 106; HAYWARD, 1980 : 703

MATERIAL — Holotype : MNHN 1534, Terre de Feu, Canal du Beagle, 1883. Other material : Discovery stns. 164, 179, 456. National Antarctic Expedition, Cape Adare; Operation Tabarin, serial nos. 1371, 1436, 1405, 1541, A441, 6220. British Grahamland Expedition, serial no. 1302, and 5.12.1935. British Antarctic Survey, Signy Id., Powell Rock, 15m, and Harpagifer Gully, 8m, 1986.

## REMARKS

This distinctive species develops thick, encrusting sheets on hard substrata. Autozooids are 0.5-0.9 mm long, with the coarsely granular frontal wall densely and evenly perforated; the ascopore is situated close to the proximal border of the primary orifice, between the paired, columnar, suboral avicularia, it is more or less circular, with a finely denticulate rim.

*Inversula nutrix* is distributed from Tierra del Fuego eastwards to Bouvet Island; it is abundant around the South Orkney and South Shetland Islands, and on the western coasts of the Antarctic Peninsula, where it occurs commonly in shore pools. However, LIVINGSTONE'S (1928) record of it from Adelie Land is the only report of *I. nutrix* from elsewhere in Antarctica. CANU (1909, cited by CALVET (1909)) recorded *I. nutrix* from Tertiary deposits of Argentina, which suggests that it is an autochthonous species in the magellanic region.

All of the material listed above has been compared with JULIEN'S (1888) type specimen from Tierra del Fuego. One large colony from the southern Patagonian Shelf was found to differ significantly from all specimens of *I. nutrix*, and is here described as a new species.

***Inversula patagonica* sp. nov.**

(Plate V, A-B)

MATERIAL. — Holotype : BMNH reg. no. 1990.12.13.9, Discovery Stn. WS88.

## DESCRIPTION

Colony forming a broad, multilaminar sheet. Autozooids oval to hexagonal, occasionally rather irregular; flat, or slightly convex, separated by distinct sutures. Frontal wall finely granular, with a single series of large marginal pores, and 30-40 much smaller, scattered, frontal pores. Primary orifice transversely oval, with a smooth rim; avicularia situated close to proximo-lateral edges of orifice, characteristic for genus. Ascopore just proximal to avicularia, transversely oval, or constricted medially and appearing reniform.

*Measurements (mm)*  
(Means and standard deviation of 20 values)

	<i>I. patagonica</i>	<i>I. nutrix</i>	<i>I. nutrix</i>
	Holotype	Holotype	Signy Id.
Autozooid length	0.58 ± 0.06	0.61 ± 0.05	0.88 ± 0.06
Autozooid width	0.40 ± 0.07	0.47 ± 0.03	0.50 ± 0.05
Orifice length	0.08 ± 0.03	0.08 ± 0.004	0.13 ± 0.007
Orifice width	0.11 ± 0.006	0.10 ± 0.006	0.18 ± 0.005



REMARKS

With ontogenetic thickening of frontal calcification, the distinction between the frontal and marginal pores of *I. patagonica* becomes less clear. However, comparison of autozooids at the growing edge with those of similar developmental stage in *I. nutrix* demonstrates the difference between the two species. In *I. nutrix*, the regularly punctured frontal wall appears almost reticulate. Antarctic specimens of *I. nutrix* (e.g., Signy Id., above) have larger autozooids, and correspondingly larger orifices, than are seen in JULLIEN's type, which is similar in size to the holotype specimen of *I. patagonica*. However, in its frontal wall morphology, the cotype of *I. nutrix* differs in no way from the Antarctic specimens listed here.

Family SMITTINDAE Levinsen, 1909

Genus HIPPOMONAVELLA Canu & Bassler in Bassler, 1934

**Hippomonavella pellucidula** (Calvet)

(Plate V, C-D)

*Schizoporella pellucidula* Calvet, 1904: 27, pl. 2, figs. 3a, b.

MATERIAL. — Discovery Stns. WS25, WS27, WS33.

DESCRIPTION

Colony forming folded, brittle unilaminar sheets, loosely encrusting sponges, cnidarians and other biotic substrata; or partly erect, forming irregular lobes; maximum size and colony architecture unknown. Autozooids elongate, rectangular, rather flat, separated by distinct sutures. Primary orifice slightly wider than long; anter transversely oval, poster with broadly concave edge, between conspicuous, bluntly pointed condyles. Orifice rim thickening in later ontogeny, but not developing a pronounced peristome. Oral spines generally absent, although a pair of inconspicuous spine bases present on a minority of autozooids. Frontal wall flat and smooth, bordered by a single series of relatively large pores. Vertical walls with small multiporous septula. Avicularia adventitious, dimorphic; most frequently short, oval, 0.1 mm long, lateral suboral or sutural in position, the rostrum normal to frontal plane and proximally directed; less frequently enlarged, with swollen cystid, 0.25 mm long, median suboral, rostrum slightly tapered distally, proximally directed. Both types of avicularia are budded from distal marginal pores of the autozooid. Ovicell hyperstomial, prominent, slightly wider than long, flattened frontally, closed by autozooid operculum; ectooecium membranous frontally, entoecium smoothly calcified, with about 30 small, round pores.

Measurements (mm)

	n	$\bar{x}$	s.d.
Autozooid length	20	0.78	± 0.07
Autozooid width	20	0.38	± 0.07
Orifice length	20	0.14	± 0.008
Orifice width	20	0.17	± 0.009

## REMARKS

The type species of *Hippomonavella* Canu and Bassler, *Lepralia praeclara* MacGillivray, was originally described from Miocene deposits of Victoria (MACGILLIVRAY, 1895), and reported from the Recent fauna of South Australia by WASS and YOO (1983). GORDON (1984, 1989) describes two further species from the Kermadec Islands and New Zealand. Colonies of *H. flexuosa* (Hutton) appear to adopt a very similar habit to those of *H. pellucidula*, and the autozooidal morphology of all of these species is remarkably similar. *H. pellucidula* was described by CALVET (1904) from specimens collected off South Georgia, from where all of the present specimens originate. It has not been reported again since CALVET's original account.

## Acknowledgements

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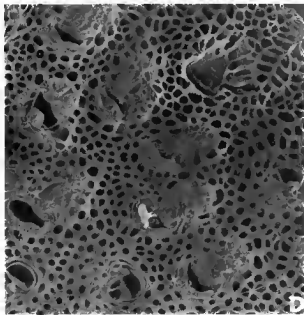
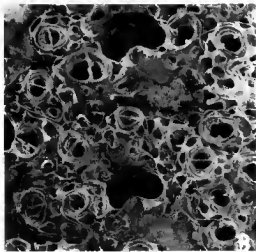
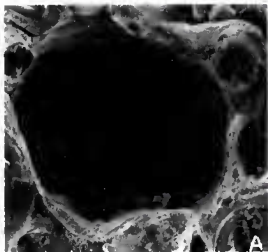
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PLATE I

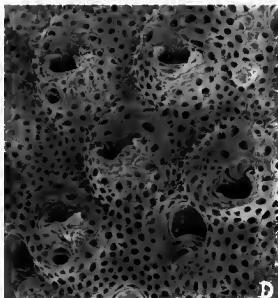
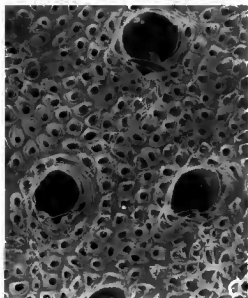
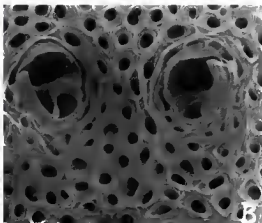
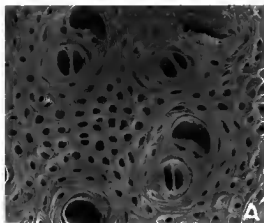
A-C : *Escharoides torquata* sp. n. : A, orifice,  $\times 165$ ; B, autozooids with numerous marginal avicularia,  $\times 35$ ; C, an ovicelled autozoid,  $\times 70$ .  
D : *Cellarinella anomala* sp. n., ovicelled autozooids at the growing edge,  $\times 33$ .



*PLATE I*

PLATE II

A-B : *Cellarinella anomala* sp. n. : A, autozooids with frontal avicularia,  $\times 50$ ; B, two autozooids with apertural avicularia,  $\times 70$ .  
C-D : *Cellarinella edita* sp. n. : C, group of autozooids,  $\times 50$ ; D, ovicelled autozooids,  $\times 32$ .



*PLATE II*

PLATE III

- A : *Cellarinella virgula* sp. n., part of a branch, showing the alternating pairs of autozooids,  $\times 60$ .  
B : *Cellarinella laytoni* Rogick, tip of a branch, with autozooids in triple whorls,  $\times 35$ .  
C : *Cellarinella virgula* sp. n., autozooids in apertural view,  $\times 80$ .  
D : *Cellarinella laytoni* Rogick, an autozoid in apertural view,  $\times 130$ .



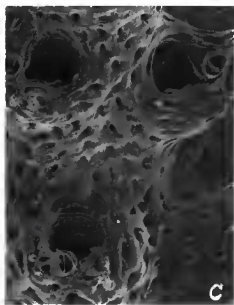
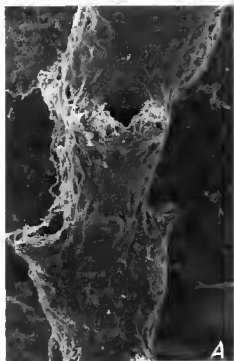


PLATE III

PLATE IV

A-B : *Cellarinella watersi* Calvet : A, frontal view of autozooids to show the apertural mucro, and paired and single avicularia,  $\times 50$ ; B, oblique view to show apertural and internal avicularia,  $\times 40$ .  
C-D : *Inversula nutrix* Jullien : C, group of fully calcified autozooids,  $\times 50$ ; D, autozooids at the growing edge,  $\times 50$ .

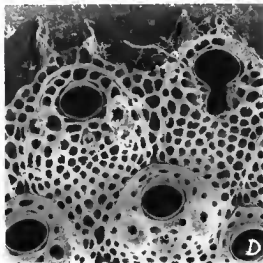
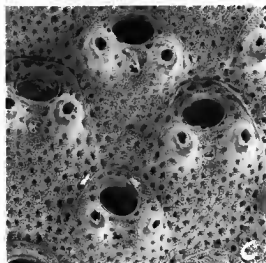
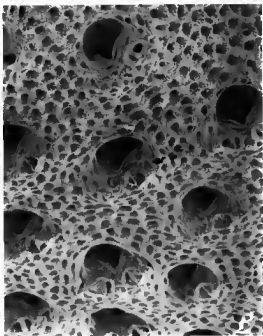
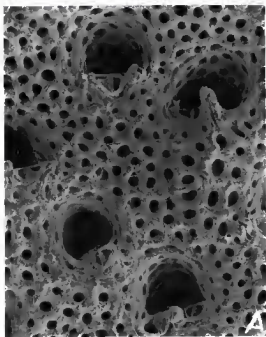


PLATE IV

PLATE V

- A-B : *Inversula patagonica* sp. nov., A, group of fully calcified autozooids,  $\times 120$ ; B, autozooids at the growing edge,  $\times 90$ .  
C-D : *Hippomonavella pellucidula* (Calvet) : C, group of autozooids, with ovicell and two types of avicularia,  $\times 60$ ; D, the primary orifice,  $\times 270$ .

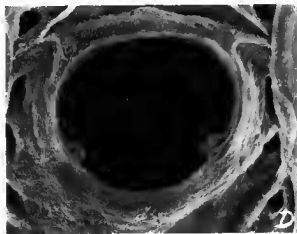
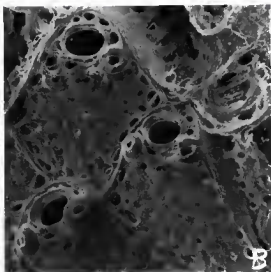


PLATE V